

ACTUAL AND POTENTIAL OPEN ACCESS TO SCIENTIFIC OUTPUT IN A SPECIFIC COUNTRY. A CASE STUDY IN ARGENTINA

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Abstract

This paper presents a methodology to estimate the real and potential access to scientific research outputs in a specific country, based on an analysis of the access model of journals used by researchers to publish their articles. It includes a study of scientific production in Argentina from 2008 to 2010 in the following areas: medicine, physics and astronomy, agriculture and biological sciences, and social sciences and humanities. The sample was taken from the Scopus database and the journal access models selected through searches performed using *DOAJ*, *e-revist@s*, *SciELO*, *RedALyC*, *PubMed*, *Romeo-Sherpa*, and *Dulcinea*. The conclusion of this study is that Argentina offers suitable conditions to provide open access to a high percentage of the scientific literature produced at the national level, using repositories. In addition, the methodology used by the authors could be potentially used by other countries and topic areas. The results provide useful knowledge for repository managers at academic and research institutions to promote repository services development and to justify their maintenance.

Keywords

Open access, Scientific production, Scholarly articles, Publication patterns, Journals, Access models, Argentina.

Título: Acceso abierto real y potencial a la producción científica de un país. El caso argentino

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Resumen

Se aporta una metodología para estimar la disponibilidad real y potencial de la producción científica de un país, según el modelo de acceso de las revistas elegidas por los investigadores para publicar sus artículos. Se estudia el caso de la producción científica argentina del período 2008-2010 en medicina, física y astronomía, agricultura y ciencias biológicas, y ciencias sociales y humanidades. La producción fue recogida de la base de datos Scopus y los modelos de acceso de las revistas, determinados a partir de la consulta a *DOAJ*, *e-revist@s*, *SciELO*, *RedALyC*, *PubMed*, *Romeo-Sherpa* y *Dulcinea*. Se concluye que Argentina presenta condiciones muy favorables para liberar un alto porcentaje de la literatura científica generada en el país bajo la modalidad de acceso abierto a través de repositorios; y que la metodología es reproducible para realizar comparaciones con otros países y campos temáticos. Los resultados aportan conocimiento útil a los gestores de repositorios de las instituciones académicas y de investigación de cara a promocionar su desarrollo y justificar su sostenimiento.

Palabras clave

Acceso abierto, Producción científica, Prácticas de publicación, Revistas, Modelos de acceso, Argentina.

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Introduction

Scientific communication is a fundamental stage of the research process. Accordingly, scientific journals are the main channel to release the outputs of almost every scientific knowledge area, and an essential means for the certification, quality control and dissemination of knowledge. However, the scientific communication model is currently undergoing profound changes whose origins must be traced back to the advances in information and communication technologies—which allow for a much faster and direct knowledge exchange and dissemination than we would have imagined years ago—and a need to reverse the current publication model where the transfer of results is slow, the big publishers have a monopoly, and the high subscription costs to periodicals are seen as obstacles to information dissemination, and, consequently, to the advancement of science itself (Gómez; Arias, 2002).

Some commercial publishers publish in OA (*BioMed Central*, *PLoS*, etc.), but authors must pay an amount (*article processing charge or fee*) to cover peer-review, layout and dissemination charges.

In recent years, the so-called "hybrid journals" have emerged: they allow free access to articles after an embargo period (Abad-García; González-Teruel; Martínez-Catalán, 2006). Recently, discussions have also begun about a blue route for OA, to refer to the creation of mandates through which research funding agencies establish that it is mandatory to self-archive the publications that they have financed (Márdero-Arellano, 2010).

To boost the visibility of OA journals, several portals have been created, such as the *Directory of Open Access Journals (DOAJ)* and *e-Revistas@Argentina* for Latin America. Another two important regional initiatives are *SciELO* (*Scientific Electronic Library Online*) and *RedALyC* (*Red de Revistas Científicas de América Latina y el Caribe, España y Portugal*), both working as OA libraries with the full text of articles of the most renowned academic journals in the region.

<http://www.doaj.org>
<http://www.erevistas.csic.es>
<http://www.scielo.org>
<http://redalyc.uaemex.mx>

In addition, various projects have emerged to gather and disseminate publishers' policies related to self-archiving permissions. At an international level, *RomeoSherpa*, with information from over 900 publishers, must be mentioned. Following the same philosophy, Spain has been developing the *Dulcinea* project.

<http://www.sherpa.ac.uk/romeo.php>
<http://www.accesoabierto.net/dulcinea>

Harnad et al. (2004) and Carr et al. (2010) estimate that, of the total number of journals adhering to OA around the world, only a small percentage take the golden route, being the green route the most extensively used. This is the only option to achieve 100% OA in the near future, since it does not require a total restructuring of the scientific publication system. Thus, authors can continue publishing their articles

“Argentina has favorable conditions to provide free open access to a high percentage of its scientific production”

The Open Access (OA) movement for scientific literature advocates for unrestricted and free-of-charge access to publications as an alternative to the traditional subscription model. One of its basic principles is to allow users to read, download, copy, distribute, print, search, or provide links to the full text of articles, without any other economic, legal, or technical barrier beyond what the internet itself may impose (BOAI, 2001); the only restriction is that authors should be granted control over the integrity of their work and the right to be appropriately recognized and cited.

The *BOAI* (*Budapest open access initiative*) states that OA can be attained through two ways: the golden route, where articles are published in OA journals, and the green route, where articles are published in traditional subscription journals and, then, self-archived in institutional or subject OA repositories, either before being published in the journal (pre-print) or afterwards (post-print).

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in their journals of choice (even if they are subscription based), and simultaneously offer open access to their work through the version they deposit in repositories. However, it is estimated that, currently, only 10% to 20% of articles are self-archived (**Harnad et al.**, 2004; **Björk et al.**, 2008; 2010). When it comes to OA publishing, **Björk et al** (2010) observed some differences in researchers' behaviour according to subject fields. In Medicine-related areas, Biochemistry, and Molecular Biology, the golden route almost doubles the green route in relative percentages (14% vs. 8%, 14% vs. 6% and 11% vs. 5%, respectively). In contrast, an inverse situation is observed for the rest of the subject areas. The fields that stand out for their adherence to self-archiving include Earth and Environmental Sciences (25.9%) and Physics and Astronomy (20.5%), followed by Social Sciences, Arts and Humanities (17.9%) and Math (17.5%). Additionally, **Miguel, Chinchilla-Rodríguez and De-Moya-Anegón** (2011) found that the situation is not the same for all geographical regions: while most journals that allow self-archiving are from the United States and Europe, in Latin America, the Caribbean and other peripheral regions they lean toward the golden route.

Post-print versions of 63% of articles published in subscription journals that permit self-archiving could be deposited (48% final author version, 15% pdf from publisher)

Several initiatives can be spotted in Latin America and the Caribbean that contribute to the strengthening of the green route through the development of institutional repositories. Starting from Argentina, the number of repositories in 2008 (**De-Volder**, 2008) to 23 in 2010 (**Mincyt**, 2010). In addition, many projects have been undertaken through the bill on the "Construction of individual and collaborative open access institutional repositories" approved by the *Chamber of Deputies* (Argentinian congress), and through the *National System of Digital Repositories, Ministry of Science, Technology and Innovation* (**Bongiovani; Nakano**, 2011). Likewise, the green route is still in its infancy in the region.

Besides institutional initiatives and national policies in support of OA, success ultimately relies heavily on researchers' awareness and adoption. **Rowlands, Nicholas and Huntington** (2004) point out that while researchers show a positive attitude towards OA journals, they mistrust their quality, especially when compared to well-established journals. Another study, funded by *JISC* and *OSI*, uncovered three other factors deemed important when choosing OA journals: free access model, publishing speed, and wide audience (*JISC; OSI*, 2004). On the other hand, according to the *SOAP survey* (*Study of open access publishing*), 90% of researchers believe OA to be beneficial to their area of research because it improves the working mode of the scientific community as a whole, offers a better financial model for scientific communication, and supports the pu-

blic good (**Dallmeier-Tiessen et al.**, 2011). Several studies in Latin America show that Chilean scientists have a medium (31%) to high (49%) level of knowledge about OA journals; in any case, only 18% of those admitting a "strong knowledge" choose them as publishing venue. Similar results were found by **Sánchez-Tarragó and Fernández-Molina** (2008) in a survey of Cuban researchers.

On the Argentinian scientific output indexed in Scopus, 69% could be accessible in open access: 25% via gold path and 44% via green path

As far as self-archiving practices is concerned, researchers either are not aware of this possibility (**Swan et al.**, 2005), or they see it as a work overload (**Russell; Day**, 2010). When it comes to self-archiving practices in Argentina, the *Mincyt* (2010) survey results bring evidence of a lack of author's participation because most existing repositories place third parties, usually librarians, in charge of depositing publications. According to the same survey, repositories show differences in volume and subject coverage. In this scenario, a study of OA articles available in these repositories would provide little information. The authors of this article believe it is important for Argentina and other countries with similar development of the green route to estimate their potential through an analysis of self-archiving policies of the journals chosen by their researchers, and so to determine what research output volume could be attained through this venue, apart from what is already available through the golden route.

Objectives and research questions

This study demonstrates a methodology to estimate the real and potential availability of a country's scientific output by analysing the journal access model their researchers choose for publication. As an example, the Argentinian case is presented, using data taken from the *Scopus* database between 2008-2010, across four subject areas: Medicine (MED), Physics and Astronomy (FIS), Agriculture and Biological Sciences (AGRI), and Social Sciences and Humanities (SOC).

This study aims at estimating what share of the scientific output corresponds to articles published in OA journals (golden route) on one side, and articles published in subscription journals that allow self-archiving (green route potential) on the other. Within each group, the percentages available as pre-print and post-print are also scrutinized.

Materials and methods

Data sources

Due to the absence of a source that records national production, the Argentinian scientific output was collected from the *Elsevier Scopus* database. Despite the subject coverage limitations this database might present for the studied case, its international and multidisciplinary features, as well as its wide subject coverage of renowned journals (about 18.500), are beyond question. In this sense, the proposed methodo-

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logy may be reproduced for similar studies in any thematic field and geographic area, thus allowing comparability of results.

The searches were performed during February-March 2011, including every article published by Argentinian researchers during 2008-2010 across the four subject areas (MED, FIS, AGRI, SOC), according to the main *Scopus* knowledge fields.

The selection criterion for records belonging to the scientific production of Argentina was the mention of any Argentinian institution in the institutional affiliation data of at least one of the listed authors.

Articles were selected and exported to an ad-hoc database, with the following subject totals: 5,839 in MED; 5,809 in AGRI; 3,710 in FIS and 1,689 in SOC (17,047 total). Journals were identified where these articles were published for every selected subject field. Following is a list of the sources that were used to identify journals according to their access model in this study:

1. *Directory of open access journals (DOAJ)*

International directory of journals on the golden route, which at the time of the query included 5,996 journals (over 9,744 as of March 2014).

<http://www.doaj.org>

2. *Scientific electronic library online (SciELO)*

Offers access to the full text of articles from 1,149 academic/scientific journals from the Ibero-American region.

<http://www.scielo.org/php/index.php>

3. *Network of scientific journals from Latin America and the Caribbean, Spain and Portugal (RedALyC).*

A portal developed by *Universidad Autónoma del Estado de México*, offering access to the full text from 901 journals.

<http://redalyc.uaemex.mx>

4. *Spanish and Latin American scientific electronic journal platform, e-Revistas*, developed by the *High Council on Scientific Research (CSIC)* and containing 955 OA scientific journals published in Latin America, the Caribbean, Spain, and Portugal.

<http://www.erevistas.csic.es>

5. *PubMed Central (PMC)* a digital collection of 1,450 OA international journals in Biomedical Sciences and Biology, developed by the *U.S. National Institutes of Health (NIH)*. Note: This source was used to analyze the area of Medicine only.

<http://www.ncbi.nlm.nih.gov/pmc>

6. *Romeo Project portal* developed by the *Sherpa group (Securing a hybrid environment for research preservation and access)* from *Nottingham University*, which provides information about self-archiving policies established by more than 1,425 academic/scientific publishers from around the world.

<http://www.sherpa.ac.uk/romeo.php>

7. *Dulcinea*, a project developed by the universities of *Barcelona* and *Valencia* and *CSIC* that provides information about publishing policies of 1,618 Spanish journals regarding self-archiving.

<http://www.accesoabierto.net/dulcinea>

For each one of these sources, journals lists were created and the data were cross-checked against another list of the journals that Argentinian researchers chose to publish their work. At the same time, journals titles were standardized and duplicate titles, i.e., titles existing in more than one source, removed. Likewise, in the case of *Romeo-Sherpa*, which provides information about self-archiving policies, a journals list was created from the titles included in *Scopus*, using a cross-check of publisher names, previously normalized.

Journal classification according to access model

Journals were classified into three groups:

- OA journals: those found in sources 1 to 5 described above. Accordingly, articles published in any of these journals were considered OA because they were published through the golden route, and so freely available, immediately or with some embargo period.
- Subscription journals with explicit self-archiving policies, included in sources 6 and 7. Articles published in these venues are considered as having "potential open access" because they can be eventually self-archived and their full text accessed through a repository or author's web page.
- Non-OA journals: those journals not allowing self-archiving, or about which no archiving-policy information is available. The latter might have been split up into two subgroups, but too few journals forbid self-archiving to justify this disaggregation.

We calculated the volume and percentage of journals included in each subset, according to their real or potential OA characteristics, for the entire group as well as for each subject field. Finally, in the case of green route journals,

Journals	MED	AGRI	FIS	SOC
Open access	1,485	885	398	723
With self-archiving permission	702	340	193	248
Publisher's post-print	26	15	25	18
Author's post-print	279	158	134	126
Pre-print	316	134	24	88
Not enough clear info	80	33	10	15
No OA information	476	394	173	222
Total journals	1,485	885	398	723
Articles	MED	AGRI	FIS	SOC
Real open access	1,967	1,310	337	728
Potential open access	2,251	2,470	2,295	519
Publisher's post-print	92	80	911	32
Author's post-print	1,044	1,214	1,015	312
Pre-print	908	964	187	146
Not enough clear info	207	212	181	29
No OA information	1,621	2,029	1,078	442
Total articles	5,839	5,809	3,710	1,689

Table 1. Number of journals and articles according to their access model by subject area.

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we also analyzed the type of permission that publishers granted regarding self-archiving, considering the categories used by *Romeo-Sherpa* and *Dulcinea*: post-print (publisher's pdf version and peer-reviewed author's version), and pre-print.

Results

Real and potential open access to scientific output. Argentine case

Our results show that, on average, 70% of internationally visible Argentinian scientific production in *Scopus* is published in OA journals or journals that allow self-archiving in digital repositories (figure 1): 27% of articles are OA, being published in OA journals (golden route) and 43% are potential OA articles (green route), since they are published in subscription journals that allow self-archiving.

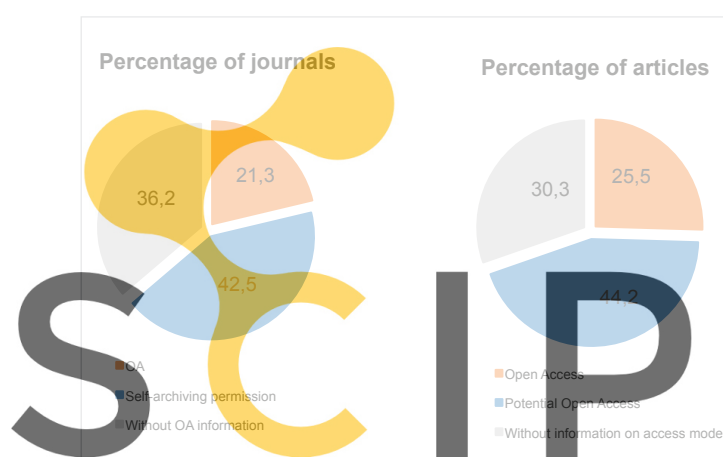


Figure 1. Journals and articles according to their access model (%)

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The golden route has the greatest presence in SOC (35% of journals and 43% of production), while the green route is the preferred option in the other fields (figures 2 and 3). In FIS, 62% of articles are potentially accessible through the green route, and a very low percentage of articles are published in OA journals (golden route).

In MED, the percentage of green route journals was twice that of the golden route (47% vs. 21%), whereas, in terms of production, these differences are more subtle (39% vs. 34%). This is mainly due to the fact that golden route jour-

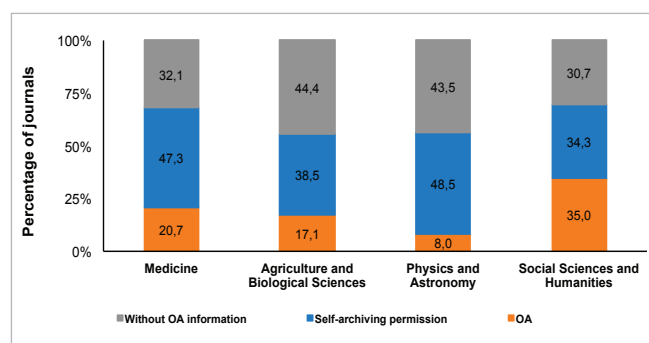


Figure 2. Journals according to access model, by subject area (%)

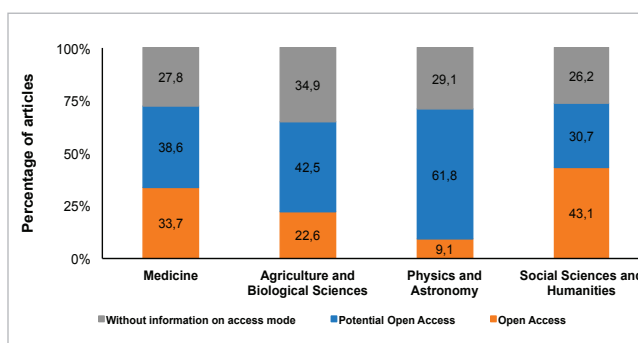


Figure 3. Articles according to their access possibilities (real or potential) by subject area (%)

nals gather a greater volume of contributions than subscription journals.

In AGRI there is a slightly more balanced distribution between journal and production ratios for both groups: 38.5% of journals and 42.5% of articles for the green route; and 17% and 23%, respectively, for the golden route.

Publication in subscription journals that permit self-archiving is more frequent in medicine, physics and astronomy, agriculture and biological sciences

The areas where we found a lower percentage of OA journals or with no information about the access model are AGRI and FIS, both less than 30%.

Potential open access according to self-archiving permissions

Overall, 63% of articles published in subscription journals might be deposited in their post-print version, with 48% as the author's peer-reviewed version and 15% as the publisher's version; 29% could be deposited only in their pre-print version. Nevertheless, no differences between areas were observed (figures 4 and 5).

In FIS, the publisher's pdf version could be self-archived for 40% of the articles gathered in a small percentage of journals (13%), whereas 44% of the peer-reviewed author's version could be self-archived in 69% of journals.

In the remaining three subject areas, the publishers's pdf version could be self-archived in 5% of articles, in about the same amount of journals. On the other hand, the peer-reviewed author's version might be available in 51% of articles in SOC, 46% in AGRI and 46% in MED. Only in this area is the percentage of articles with pre-print permission greater than that of post-print (45% vs. 40%).

In all four subject areas, 50%-60% of articles are concentrated among 3 or 4 publishers. *Elsevier* is placed first in all cases, with 20% of articles published; *Blackwell* and *Springer* stand out in AGRI; *Blackwell*, *Lippincott*, *William & Wilkins* and *John Wiley & Sons* in MED; *John Wiley & Sons*, *Springer* and *SAGE Publications* in SOC. Finally, in FIS, the second

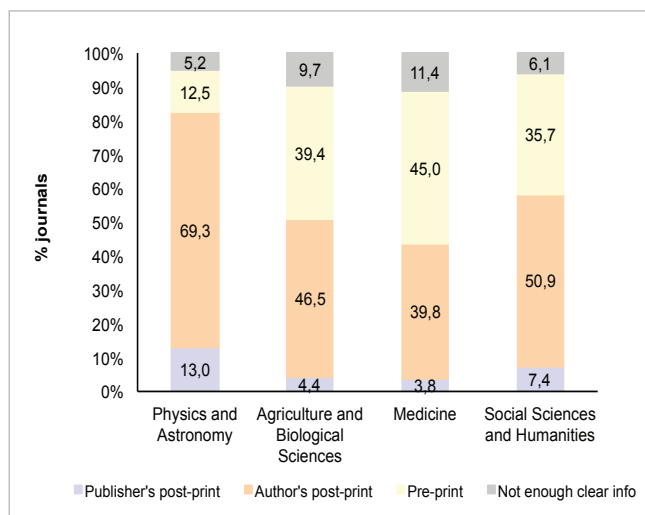


Figure 4. Journals according to self-archiving permission (%)

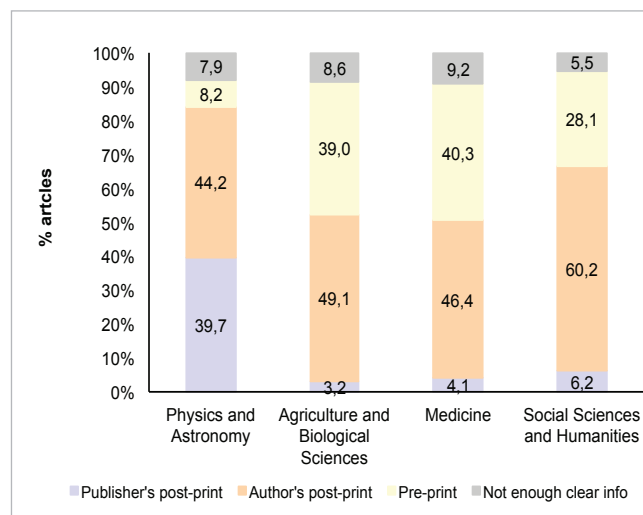


Figure 5. Potentially accessible articles according to self-archiving permission (%)

and third most important publishers are *American Physical Society* and *American Institute of Physics*. These two non-commercial publishers have significant weight in this area of research, and their journals are chosen by researchers in Physics and Astronomy to publish a vast amount of articles. As a result, a high percentage of articles can be potentially self-archived in their publisher's pdf version. This cannot be verified in the remaining thematic areas.

Conclusions

There are extremely favourable conditions for Argentina to include a significant share (69%) of its scientific production in *Scopus*, freely available through OA. This production is published in journals that adhere to some form of OA, in a ratio of 25% for the golden route ("real open access") and 44% for the green route. In comparison with the 25% for the golden route to the 8.5% encountered by Björk *et al.* (2010) on an article-per-article basis verification at a world level, the figures for Argentina triple; this represents a considerably positive difference for the country. The reasons may be found in a Latin American trend towards the golden route, such as pointed out by Miguel *et al.* (2011) or, alternatively, they may lie in the fact that we have assumed that all articles are free, which has not been verified (some OA journals in *SciELO* and *RedALyC* are subject to embargo periods from 6 months to 1 year). Another study should be carried out to confirm or contradict these findings.

Taking into consideration the aforementioned 44% potential access, this study supports the Harnad *et al.* (2004) thesis that the best way to release scientific literature is through the adoption of self-archiving practices, be it as pre- or post-print. Out of this 44% accessible through the green route, 62% might be deposited in its post-print version, the larger share as peer-reviewed author's version and a smaller one as the editor's version. Further studies might be needed to ascertain the extent to which these articles were posted in repositories, especially in areas like FIS and MED, both with a recognized track record to making information freely available through *arXiv* and *PubMed*, respectively.

The results provide useful knowledge for repository managers at academic and research institutions to promote the green route. At the same time, authors should be made aware of the possibility of providing legal open access through self-archiving their post-prints. Unawareness of permissions granted by publishers is one of the main obstacles for authors' self-archiving practices (Swan; Brown, 2005). Increasing the number of articles (above all, the final publisher's version) with self-archiving permissions should be negotiated with publishers.

On the other hand, this study reinforces what has already been pointed out by Björk *et al.*, (2010) and Miguel *et al.* (2011), in the sense that the OA influence is not the same across all fields. In the case of Argentina, the golden route is more heavily represented in SOC than in the other fields (FIS, AGRI and MED), where the bigger percentage lies in subscription journals with self-archiving permissions.

Knowledge of the OA publishing practices of each discipline is key to the advancement of policies and actions that facilitate and encourage OA development

There is no doubt that a knowledge of OA practices and trends in each academic discipline community is key to move forward with policies and action steps that favour and promote its development even further, in accordance with patterns that are unique for each field of knowledge. This study is certainly a valuable contribution in that direction.

As a final conclusion, this paper provides a methodology that can be reproduced in other cases (countries, institutions, subject fields), allowing for comparisons that will help raise knowledge about real and potential OA in different scenarios.

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